



International Space Station Considerations

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ESSP Conference

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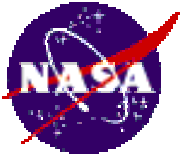
Manifesting

- Attached payload sites are allocated to and belong to the Enterprises, managed by the RPOs
 - Code Y owns 25% attached payload sites
 - AA determines how to use the allocation
- Individual pallet and JEM-EF topologies are worked by RPOs, ISS Program, and International Partners
- OES has placeholders on nadir pallets



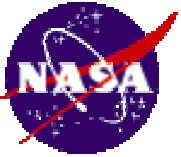
Manned Flight Safety

- STS and ISS safety review system combined for flight and ground
 - Must pass through JSC Payload Safety Review Panel (PSRP)
- Substantial documentation increase over ELVs
- Significant safety oversight required
 - Safety and hazard verification
 - Safety engineer is a necessity
- Level of rigor independent of payload size or \$ value
 - 3 step review process
 - Phase 1 review within 3 months of PDR



Viewing

- Truss sites will have partial, periodic obstruction of viewing by solar arrays, visiting vehicles, other instruments
 - Payloads won't be operating during visiting vehicle proximity operations
- Software tools for field-of-view analysis on ISS have been developed by several organizations
 - Top level analysis can be accommodated by the RPO
 - Sources available for more detailed or time-consuming analysis



Guidance Navigation & Control

Attitude Knowledge/Pointing

- ISS attitude knowledge will be reasonably well known and stable, but knowledge at the location of payload may need to be augmented
 - Nadir truss payloads have limited view of GPS constellation and currently no direct access to star tracker data
 - JEM-EF payloads have simultaneous capability for nadir viewing and star tracker data
 - Columbus EPF payloads will have partial GPS viewing
- ISS attitude holding requirement (2.5 degrees per axis per orbit) may need to be augmented by payload pointing (e.g., HEXAPOD for SAGE III)



Guidance Navigation & Control

- ISS induced jitter environment and requirements on payload induced disturbances need to be characterized for all sites
 - Preliminary induced environment number available for full truss sites only
 - Requirements documented for full truss and pallet payloads

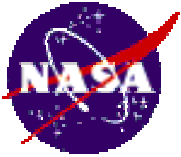
Altitude

- Can vary from 190 to 250 nmi with smaller short-term variations superimposed on longer solar-cycle induced variation
 - Attitude reboost anticipated approximately every 3 months



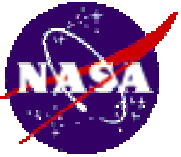
Power

- Power duty cycle and operational scenarios are not yet characterized
- Power allocations will be less than site capabilities
 - Allocations and related policies are in the process of being worked
 - Allocations for all resources are shared between
 - NASA and the International Partners
 - RPOs
 - RPO distributes to payloads
- Survival Power for pallet payloads
 - 28V only for heaters during shuttle transportation
 - 120V only for heaters on pallet



Thermal

- Thermal
 - Limited capability to reject heat on EXPRESS Pallet sites
 - The EXPRESS Pallet itself has no active thermal control system for payloads
 - Radiated heat from neighboring payloads must be considered at all sites



Data Handling/Communication

- Command via S-band by file transfer or individual commands
- Telemetry via KU band with incomplete coverage
- ISS only provides data storage for data being dumped to the system during communication outage
 - Payloads must provide own storage for science data and capability to burst at max high rate (6 Mbps on pallet)
- Allocations are still in preliminary discussions



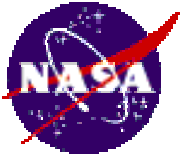
Contamination

Environment

- Molecular Deposition of the ISS Environment = 130A/yr
- Do not have a consistent, station-wide monitoring program

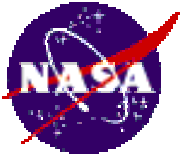
Payload Contamination

- Requirements for full truss and pallet payloads
 - Molecular column density along unobstructed line of sight from other truss payloads not to exceed 1×10^{-14} molecules/cm² per species
 - Molecular deposition not to exceed 1×10^{-14} gm/cm²/sec on other attached payloads
 - Molecular deposition not to exceed 1×10^{-15} gm/cm²/sec on ISS sensitive surfaces
- Requirements for JEM-EF not yet defined
- ASTM-E1559 testing data required for materials
 - Materials lists will be worked with ISS contamination group



Simulators

- Simulators
 - Simulator resources for payload developers may be inadequate
 - May need to plan on using KSC payload test and checkout resources for risk mitigation
 - Scheduling of resources and cost could become an issue

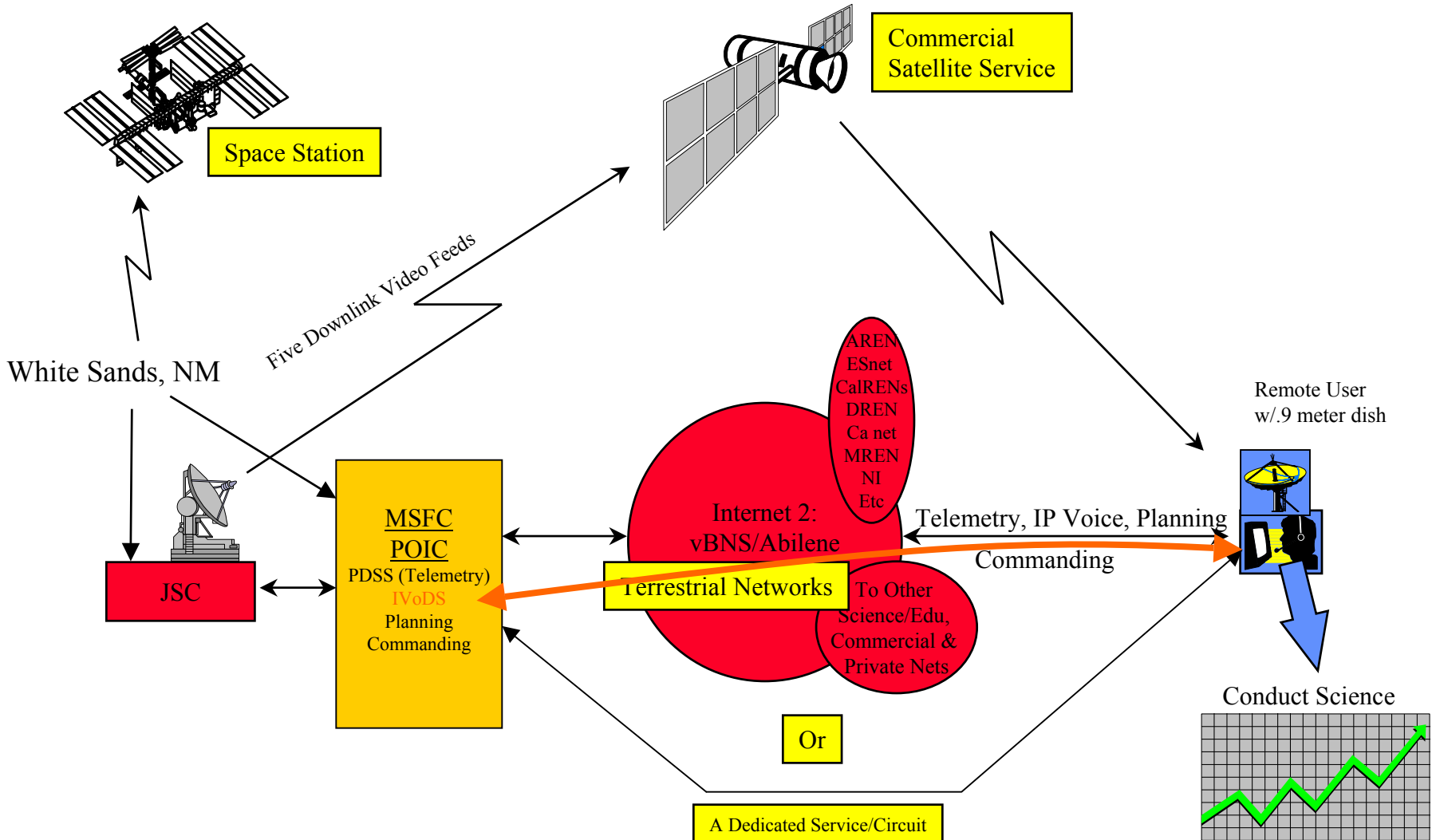


Crew Time and Training

- Crew training and crew time are limiting resources
 - Advisable that attached payloads limit payload required crew interaction on orbit as much as possible
- “Standard” operations don’t require Payload Developer (PD) input, e.g. robotic placement
- Unique payload handling on-orbit requires training procedures, documentation
- Crew familiarization package to be provided by PD
- Contingency operations involving crew intervention will require ground or on-board training



Operations





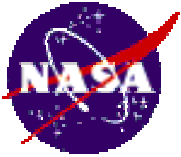
Operations

- Code Y will not have a Telescience Support Center (TSC)
- Individual payloads will provide operations connected directly to MSFC Payload Operations Integrated Center (POIC)
 - Telescience Resource Kit (TReK) software provided by ISS at minimal cost for command and telemetry
 - TReK can run on desktop computer in a secure environment
 - Can have TReKs in multiple locations with one site designated for commanding



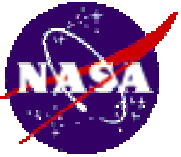
Retrieval

- Payloads must be returned to ground
- Retrieval planning must take place prior to launch
- Payload anomalies and configuration changes must be tracked while on-orbit
- Safety re-assessment requires original design documents and operations records be maintained
- Retrieval Certification of Flight Readiness (CoFR) and Safety review required
- De-integrate from STS and return payload to PI
- MO & DA budget must include reserved retrieval costs



Recommended Reading

- EXPRESS Pallet Interface Definition Document, Working Draft 5
 - SSP 52000-IDD-EPP
- EXPRESS Pallet Payload Accommodation Handbook, Working Draft 3
 - SSP 52000-PAH-EPP
- EXPRESS Pallet Generic Payload Verification Plan, Working Draft 3
 - SSP 52000-PVP-EPP
- Payload Integration Requirements Document for Unpressurized Payloads
 - SSP 57061
- Payload Integration Requirements Document Increment Addendum Blank Book
 - SSP 57062
- Space Station Program Requirements for Payloads
 - SSP 50431
- Space Station GN&C Overview for Payloads



Recommended Reading

- Also available on the RPO website
 - Typical Schedules
 - Reviews
 - Deliverables
- ISS documentation typically located behind firewalls at JSC, MSFC
 - Can request what you need through RPO
 - Register with JSC for access
- Payload Data Library (PDL)
 - In addition to document deliverables, payload data is entered into the PDL on-line
 - Data is used by multiple organizations, limiting redundant request to payload developers



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